The Ordovician–Silurian boundary in Bolivia and Argentina

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Synopsis

The Ordovician–Silurian boundary level has been identified in few areas, although there is considerable potential for future work. The following sections are the best: 1 Lampaya, Bolivia; 2 the Don Braulio Valley, Argentina; 3 Talacasto, Argentina. Recent fieldwork has established that Talacasto appears the best of these, and a sequence of *persculptus* Zone, probably *acuminatus* Zone, and approximate equivalent of the *atavus* Zone has been established. The base of the Silurian at Talacasto is taken at 60 cm above the base of the La Chilca Formation, following a *persculptus* Zone assemblage. Several stratigraphically important graptolites are recorded from South America for the first time.

Introduction

In Bolivia undoubted low Silurian rocks are exposed in the Eastern Cordillera, and in Argentina in the Precordillera (Fig. 1). The Cancañiri Formation is the basal unit of the Silurian in Bolivia (Castaños & Rodrigo 1978) and consists of 105 m of diamictites, shales and sandstones yielding palynomorphs and, in some sections, scarce brachiopods. The Precordilleran Argentinian Silurian is recognized as three facies types: the Eastern Facies, some 2500–3000 m of shales, sandstones and conglomerates with associations of brachiopods, corals and graptolites; the Central Facies, 450–500 m of green shales, orthoquartzites, and fine grained limestones, with rich assemblages of brachiopods, corals, trilobites and graptolites; and the Western Facies, restricted to the Calingasta region, approximately 1000 m of shales and turbidite sandstones, yielding some brachiopods. Each facies type (Cuerda, in press) is interpreted as having a different palaeoenvironment, respectively: a N–S trough between Pre-Cambrian ridges; proximal to distal platform; distal platform to abyssal plain. The stratigraphically lowest formations in these facies are the La Rinconade Formation, the La Chilca Formation, and the Calingasta Formation.

Bolivia

The Lampaya section is located near Cochabamba. Three lithological units have been recognized in the Silurian, the Cancañiri Formation at the base, and above it the Kirusillas and Catavi Formations, a total of 1355 m spanning the Llandovery to Ludlow. The Ashgill Series seems to be absent in Bolivia so that the Cancañiri Formation rests upon Caradoc or earlier strata. At Lampaya the Cancañiri Formation consists of 105 m of diamictites with shales and sandstones intercalated as thin layers. A Llandovery age is supported by palynomorphs referable to the *Veryhachium rhomboidium* Zone (Suarez-Riglos 1975). Macrofossils have been recovered including trilobites, brachiopods, corals and ostracods by one of us (A.C.). The Cancañiri Formation at Lampaya rests upon the Caradoc.

Argentina

Villicum Hills Section. The Don Braulio Valley drains the eastern slopes of the Villicum Hills, where the Ashgill black shales and grey sandstones are topped by a ferruginous oolite. The grey

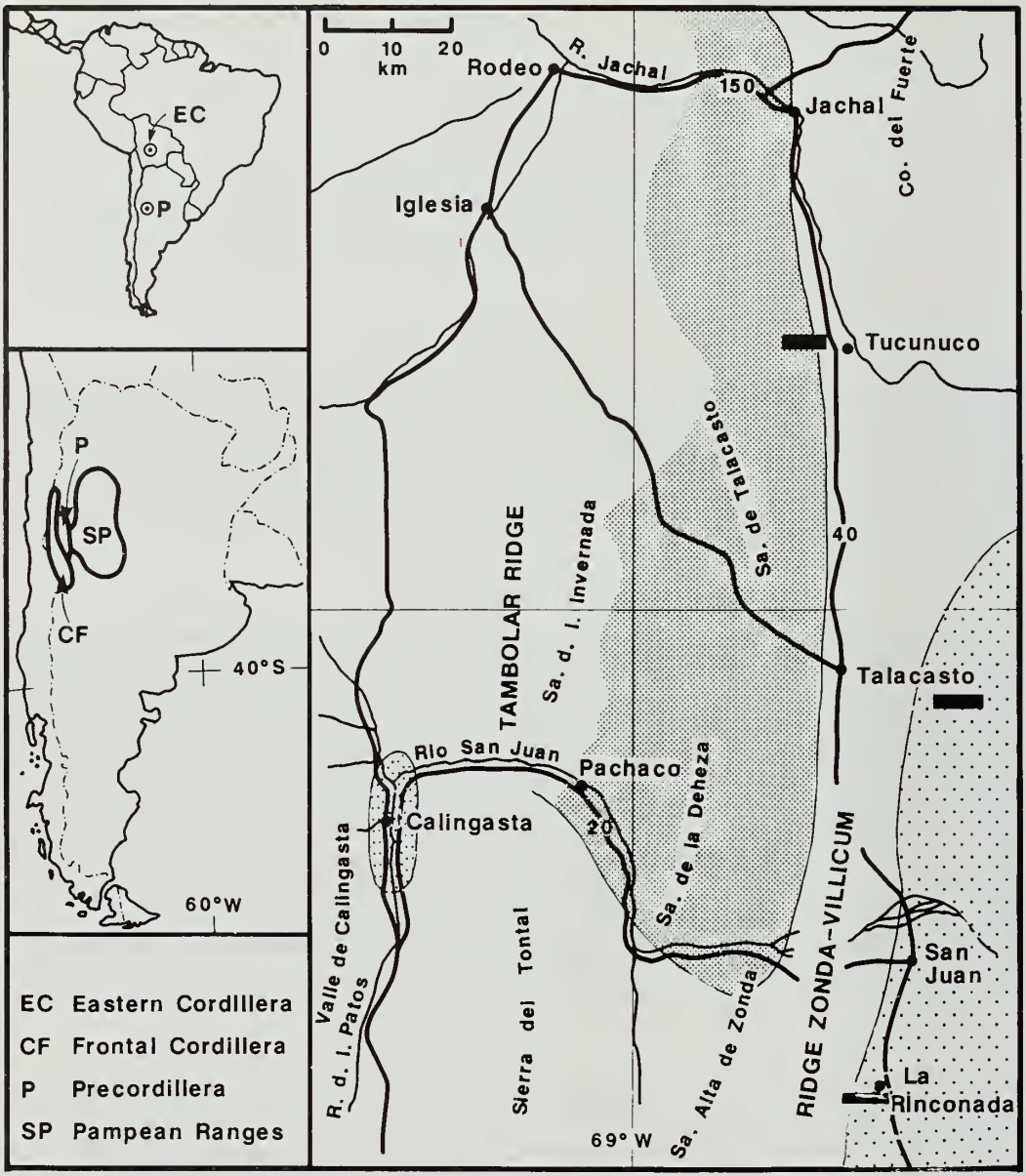

Fig. 1 Distribution of Silurian facies in the Precordillera of San Juan, Argentina. The western facies is shown around Calingasta, the central facies in the close stipple and the eastern facies in open stipple to the right.

sandstones have yielded the trilobites *Calymenella* (*Eohomalonotus*) *villicumensis* Baldis & Blasco and *Dalmanitina sudamericana* Baldis & Blasco (Baldis & Blasco 1974) and the brachiopods *Fascifera punctata*, *Arenorthis cuyana*, *Villiscundella muozetici*, *Bagnorthis garrigoui* and *Kjaerina* (*Neokjaerina*) *florentina* (all Levy & Nullo 1977).

The Silurian commences with argillaceous sandstones and has a palynomorph assemblage referable to the Llandovery, which Volkheimer *et al.* (1980) list as *Ancyrochitina* sp., *A.* cf.

ancyrea (Eisenack), *Conochitina* cf. *chydaea* Jenkins, *Desmochitina* sp., *Cyathochitina* cf. *campanulaeformis* Eisenack, *Euconochitina* cf. *filifera* Tangourdeau, *Rhabdochitina* sp. 'A', *Spathochitina* cf. *clarindoi* de Costa and *Sphaerochitina* sp. Above the argillaceous sandstones the beds grade into medium and coarse sandstones of Wenlock and Ludlow age (Magotes Negros Formation). Baldis & Pöthe de Baldis (1988, this volume) have reviewed and revised this section.

The **Talacasto** section (Figs 1, 2) is located some 16 km WNW of Talacasto railway station and has been studied by Cuerda *et al.* (1982). Recent collecting by the authors yielded several hundred graptolites throughout the whole of the 3·65 m of the La Chilca Shale Formation. Collecting was done every few centimetres, as closely as the friability of the shale would allow. Several confirmatory collections were made nearby. *Glyptograptus persculptus* occurs commonly, both flattened and in three dimensions, in association with equally common specimens of *Climacograptus angustus* Perner and in addition *Pseudoclimacograptus* sp. nov., *Glyptograptus* sp. (an undescribed form commonly seen in the *persculptus* Zone in other parts of the world), *Climacograptus* cf. *medius* Törnquist, and *Climacograptus normalis* Lapworth. This assemblage is taken to indicate the latest Ordovician *G. persculptus* Zone.

At 55 cm above the base of the formation *G. persculptus* s.s. disappears, but the remainder of the fauna continues. *Rhaphidograptus* sp. at 90 cm, and *G.* ex gr. *persculptus* (late forms, smaller, and with a delayed median septum) also occur between 1·1 m and 1·38 m, where *Pseudoclimacograptus* sp. nov. is also especially abundant and dominates the fauna. The *Pseudoclimacograptus* sp. nov. is close to *P. fidus* and *P. pictus* described from the *acuminatus* Zone of Kazakhstan by Koren & Mikhailova (1980). From 60 cm to 1·7 m we have recorded specimens

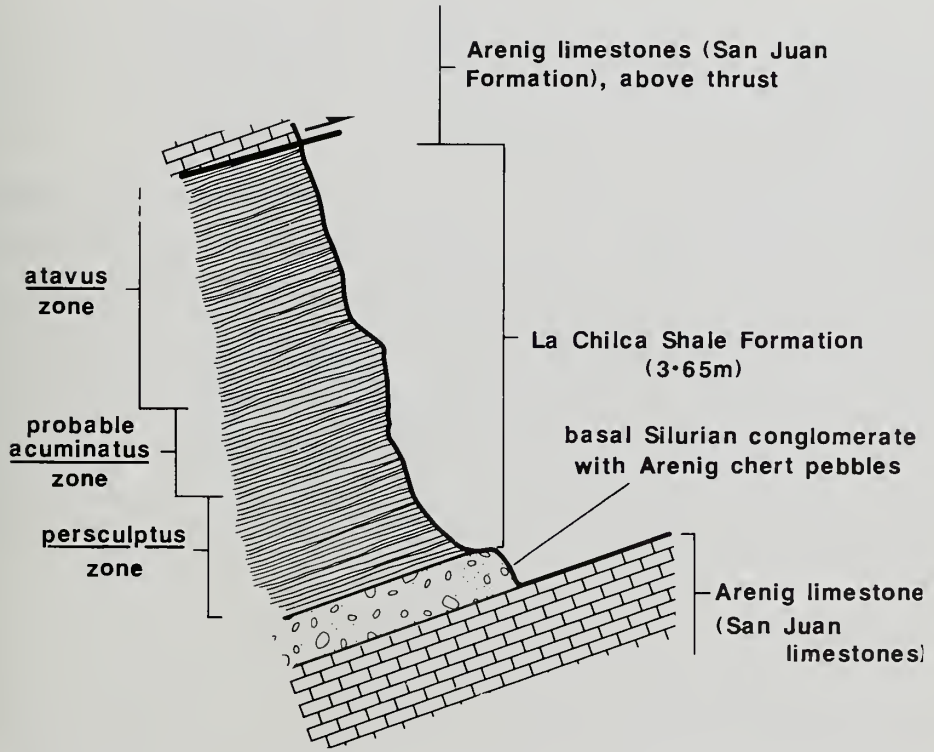

Fig. 2 Section through the Ordovician–Silurian boundary near Talacasto, San Juan Province, Argentina. The 'basal Silurian conglomerate' also includes the *persculptus* Zone.

of *Climacograptus acceptus* Koren & Mikhailova, also typical of the *acuminatus* Zone, and we have found specimens possibly referable to *Glyptograptus maderni* Koren & Mikhailova from 60–90 cm. At 1·6 m there is a further change in the fauna, with the disappearance of glyptograptids and the *Pseudoclimacograptus*, whilst there is an increase in abundance of *C. angustus*, *C. normalis* and *C. rectangularis* and the appearance for the first time of the monograptid *Lagarograptus*. *Paraclimacograptus* cf. *innotatus* (Nicholson) appears at 1·75 m. This fauna is then maintained to the top of the section apart from the addition of a new diplograptid.

The base of the *acuminatus* Zone, and hence of the Silurian, is probably best taken at 60 cm with the appearance of *Climacograptus acceptus*. For reasons which we shall discuss in a systematic paper elsewhere, we take the incoming of *Lagarograptus* to be roughly equivalent to the *atavus* Zone.

Thus the Talacasto region at present affords the best recognition of the base of the Silurian in South America. The potential is considerable for further precise subdivisions on other sections in the same region. The authors' recent fieldwork established the following stratigraphically important forms for the first time in South America: *G. persculptus*, *C. angustus*, *C. normalis*, *C. acceptus*, *C. rectangularis*, *Rhaphidograptus*, *Paraclimacograptus*, and *Lagarograptus*.

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